REPORT OF THE STUDY TO ASSESS THE IMPLEMENTATION OF THE FOOD GRAIN TECHNOLOGY VERIFICATION PROJECT

I INTRODUCTION

In September and October, 1990 a study was undertaken at the request of OAU/STRC SAFGRAD Coordination Office, Ouagadougou, Burkina Faso, to assess the implementation of the "Food Grain Technology Verification Project" of SAFGRAD. The study took place from 18 September to 3 October, 1990.

1.1. Itinerary

The following research institutes/stations were visited on the dates indicated

Name of research station/institute	Dates visited
(i) Ministere de L'Agriculture et de L'Elevage, INRAN, CNRA, Tara, Maradi, Niger	18-19 Sept.
(ii) Institut National de Recherches Agronomiques du Niger (INRAN), Kolo Station, Niamey, Niger	21-22 Sept.
(iii) Nyankpala Agricultural Experiment Station, Crops Research Institute (CRI), Nyankpala, Tamale, Ghana	25-26 Sept.
(iv) Institute d'Etudes et de Recherches Agricoles (IN.E.R.A.), Station de Recherches de Kamboinse, Burkina Faso	27-28 Sept.
(v) INRAN, CNRA, Tara, Maradi, Niger	01 October
(vi) Institute for Agricultural Research (IAR), Samaru, Ahmadu Bello University, Zaria, Nigeria	15-16 Oct.

1.2. Terms of Reference

The terms of reference for the study, as specified by the SAFGRAD Director of Research, were as follows:

(i) to assess the status of the project implementation,

(ii) to identify problems encountered by the researchers in executing the project,

(iii) based on the appraisal, to draw technical recommendation .

1.3. Approach Used in the Study

The study was executed by visiting the research institutes/stations, discussing the work done to execute the project with researchers, their field technicians and, wherever necessary, with the management of the stations/institutes. The field trials were then visited in order to get a full impression of the work being done.

The report below covers work on the sub-projects executed by each of the five participating research stations (two in Niger and one each in Burkina Faso, Ghana and Nigeria). Because of diverse nature of the sub-projects (in terms of objectives and methologies), each of the above three terms of reference were considered in the report on each sub-project.

II PROJECT IMPLEMENTATION IN BURKINA FASO

2.1. Sub-Project Title: Technology Evaluation under Farmer's Conditions in the Rural Areas of Burkina Faso

2.2. Objective: To evaluate the adoptation, performance and acceptability of improved technological packets under the real conditions of the farmer.

2.3. Name of Research Institution: Institut d'Etudes et de Recherches Agricoles (IN.E.R.A.), Programme Oleagineux et Legumineuses a Graines Proteagineux, Station de Recherches de Kamboinse, Burkina Faso.

2.4. Researchers:

2.4.1. Principal Researcher: Mr. Jeremy T. Ouedraogo, Cowpea Breeder

2.4.2. Collaborators: (i) Dr. (Mrs) C. Dabire, Entomologist. (ii) Several technicians responsible for Sub-project execution in different groups of villages.

2.5. Description of Locations: On the whole, 123 farmers are involved in the Project. They were selected from 15 districts representing the ecological zones (the Sahel, Sudan savanna and northern Guinea savanna) in Burkina Faso. The distribution of the farms in 1990 were as follows:

District/location	Number of farmers
Central	8
East Central	7
North Central	4
West Central	10
South Central	5

(Burkinabe Trials)

District/location	Number of farmers
Eastern	5
Bobo-Dioulasso	10
Mouhoun	10
Northern	40
Sahel	5
South West	5
Unite de Planification 1	5
Loumbila	3
Kamboinsin	3
Pobe	5

The mean annual rainfall varies from about 300 mm (in the Sahelian zone) to about 1,200 mm in northern Guinea savanna. As expected within such a vast region, the soil type and soil fertility vary a great deal (from the sandy soils of the Sudano-Sahelian zone to the clay loams in the Guinea savanna).

2.6. Farming Practices of Farmers Involved in the Sub-Project

2.6.1. Cropping system. Traditionally the farmers grow their crops in cereal-based mixtures. Millet and sorghum are the predominant cereals while maize is ranked third, after millet and sorghum. Cowpea and/or several vegetable crops are grown as secondary crops in the cereal-dominated cropping system; occasionally cowpea is grown as sole crop. Groundnut and cotton are usually grown in pure stands.

2.6.2. Application of organic manure. Organic manure (compost and/or animal droppings) are applied to farms close to the homesteads. The main animals kept by farmers are donkey, goats, sheep, poultry and pigs. Dung is also derived from cattle that are owned mostly by normadic herdsmen.

2.6.3. Land use. Arable land is cultivated each growing season (i.e., no fallow period) because of the population pressure on land.

2.6.4. Integration of livestock and crops. The animals provide organic manure as outlined above. Additionally, donkeys are used in transportation as beasts of burden. Cowpea and groundnut residue (haulms and remains of threshed pods) are fed to ruminant animals.

2.7. Production Inputs

2.7.1. Land preparation and planting. Land is prepared manually with the aid of family labour. Planting is usually on ridges, but quite good number of farmers plant on the flat. Some farmers tie their ridges towards the end of the rains, to conserve moisture.

2.7.2. Fertilizer use. Of the six farmers visited during the tour, only one (a retired police officer) used artificial fertilizer (NPK as basal dressing for both maize and sorghum). The rest were aware of the benefits of chemical fertilizers but did not apply them because they could not afford to buy them.

2.7.3. Crop protection measures used by farmers. Under the normal conditions at the farmers' level, no specific crop protection measures are employed during the growing season, except those incidental to routine crop production practices. An input being introduced by the project is insecticidal spray for cowpea. However, farmers traditionally protect cowpea grains from beetle damage with ordinary ash; only one farmer uses phostoxin in this respect.

2.7.4. Weed control at farmers' level. No herbicides are used; weeding is done with hand-held hoe.

2.7.5. Family labour input. Family labour is the main source of labour; the effectiveness of labour is enhanced by the largely polygamous marriage system in the rural areas. A common practice is that able-bodied men from different families constitute themselves into a labour gang that works in a systematic rotation from one family farm to another during the peak labour periods. The arrangement is popular with the men because they claim that the gang is fed much better by the host farmer compared to the meals they are served when each member works on his own in his own farm.

2.8. Data Collected During the Study

2.8.1. Number of farmers within sub-project area. Given the large area in which the 123 farmers were located, it was not possible to estimate the total

number of farmers in the sub-project area. However, in Sao village, 55 km from Ouagadougou, there were about 500 farm families.

2.8.2. Yields of crops. In Sao village area, sole sorghum and millet crops produce, respectively, 800-900 and 600 kg of grain per hectare; sole crop groundnut yields 700-800 kg of pods per ha, while grain yield of unsprayed sole crop cowpea is less than 200 kg/ha. Data on yield of crop mixtures were not readily available but they would be provided in the technical report by the Principal Researcher.

2.8.3. Farmers' reaction to the sub-project. All of the six farmers visited during the study were extremely receptive of the sub-project. Five of them had sprayed their cowpea crops twice, as recommended in the package being evaluated, and the differences in grain yields between sprayed and unsprayed cowpea were outstanding. (Failure to spray one farm was attributed to non-provision of insecticides by the supervising technician.) The farmers were also convinced that the two improved cowpea varieties (see below for details) were better than the respective local varieties. They were particularly pleased with the earliness of the improved varieties, most of which had been picked at least once at the time of the visit, while the locals were still to mature. The participating farmers would like to commit more of their land to the testing of the improved package in 1991, if the inputs, especially insecticides, would be provided.

2.9. Materials and Methods: The following six improved cowpea varieties were evaluated in different ecological zones, either in pure stand or in mixture with sorghum or millet.

Cowpea variety	Suitable rainfall range (mm) for production	Recommended method of planting
KVx 30-309-6G	300-900	Pure or mixed
KVx 61-1	300-900	Pure stand
KVx 396-4-4	300-1200	Pure or mixed
KVx 396-18-10	300-1200	Pure stand
TVx 3236	300-1200	Pure or mixed
KN-1	700-1200	Pure

Each farmer was allowed to decide which two of the above six improved cowpea varieties he wished to produce, in comparison with his local variety of cowpea. The farmer was also allowed to decide whether or not he wished to grow the three cowpea varieties in pure stand or in mixture with millet or sorghum. The minimum plot size was 25 x 25 m (625 m^2). Yields would be jointly estimated by the farmer and the technician.

2.9.1. For production of sole crop cowpea: Land was cultivated before planting, while 100 kg of Burkina phosphate was applied at planting.

Data of planting in the zone with 300-600 mm of rainfall was the end of June to early July. In the zone with 600-1200 mm of rainfall, the sowing date was 15-25, July.

(Burkinabe trials)

Spacing between the rows was 75 cm, while the intra-row spacing was 20 cm. Two seeds were sown per hole; 14 days after planting, the seedlings were thinned to 1 per hill.

Two insecticide sprays were given: one at flower bud formation (about 35 days after sowing) and the other at pod formation (about 14 days after the first application). A mixture of Decis and Rogor (1 litre of each product/ha or 40 ml of each product in 20 l of water). For the second application, a tank mixture of 20 ml of Decis and 20 ml of Rogor in 20 l of water could be used instead of the above, higher rates.

2.9.2. For cowpea/cereal mixture: Date of planting of the cereal was the date recommended for it in respective ecological zones.

In the zone with 300-900 mm of rainfall, cowpea was planted at the same date as the cereal. In the higher rainfall zone (900-1200 mm), cowpea was sown 14-21 days after the cereal.

Mode of planting: 2 rows of cereal alternating with one row of cowpea. Inter row spacing was that recommended for the cereal component of the mixture. Within the row spacing for cowpea was 20 cm while within the row spacing for the cereal was two thirds of the spacing recommended for the sole crop; for example, if the practice was to sow the cereal at 60 cm intra-row spacing for the pure stand, the spacing used in the trial was 40 cm.

(Burkinabe trials)

The rate and kind of fertilizer used were as recommended for the cereal component in respective ecologies.

Insectide application to cowpea in the mixture was similar to that applied to the sole crop.

2.10. Problems Encountered by Researchers in Sub-project Implementation

The major problem was the rapid turn-over of technicians handling the trials. In a few cases, such transfers were made in the middle of the season. Another, rather minor problem, was the somewhat late arrival of insecticides ordered from Abidjan (Cote d'Ivoire); however, this is unlikely occur in future with timely provision of funds.

2.11. Status of Sub-project Implementation

The trials conducted in Burkina Faso were executed according to the project document.

2.12. Suggestions by the Assessor

(i) The size of the project in the Burkina Faso should be reduced. Instead of 123 farmers included in 1990 trials, only about 45-60 should be studied in subsequent years - the reduction can be effected by using only 4-6 farmers per district or location.

(ii) Ministry of Agriculture Officials should be persuaded to desist from unnecessary transfers of technicians involved in the sub-project. Specifically, on no account should a technician be transfered from the sub-project during the growing season.

(iii) The quality of service rendered by technicians could be improved by further training.

(iv) On the whole, the researcher is a highly motivated scientist. One aspect of his high productivity was that his National Programme provided him with a four-wheel drive vehicle. This facilitated his work and every effort should be made to maintain the vehicle in sound mechanical condition.

III. PROJECT IMPLEMENTATION IN CHANA

3.1. Sub-Project Title: One Farm Agronomic Research in the Northern Sector of Ghana.

3.2. Objectives:

(i) To test, at the farmer's level, new crop varieties and improve technologies developed at research stations, in comparison with farmers' traditional practices.

(ii) To develop adoptable recommendations for, and with, the Agricultural Extension Services of Ghana.

3.3. Name of Research Institute: Nyankpala Agricultural

Nyankpala Agricultural Experiment Station, Crops Research Institute (CRI), Nyankpala, Tamale, Ghana.

3.4. Researchers and Cooperators

3.4.1. Principal Researcher: Dr. L. O. Tetebo, On-farm Testing Agronomist.

3.4.2. Collaborators and linkages:

(i) Dr. K. O. Marfo, CRI, Nyankpala, Tamale

(ii) Crops Services Department, Ministry of Agric., Ghana.

(iii) Extension Services Department, Minsitry of Agriculture, Ghana.

3.5. Description of Location of Trials

There are two separate groups of trials, one group separated from the other by over 300 km. The two groups are as follows:

(i) Group 1: Bimbilla District. Located in south eastern sector of Northern Ghana; 10 villages were used for the study, three farmers being selected from each village to give a total of 30 farmers. The total farming families is about 2,500. The soil

type in Bimbilla District is clay-loam; soil fertility is somewhat better than that in Wa and Nadowli Districts. Because of the low population density, the pressure on the land is low; consequently the fallow period varies from 5 to 15 years. The District, with an annual rainfall of 1400 mm, is located in the northern Guinea savanna ecological zone.

(ii) Group 2. Wa and Nadowli Districts: In upper west sector of Northern Ghana. There are five villages from which 22 farmers used in the study were pre-selected, with the help of the Crops Services Department of the Ministry of Agriculture. The soil type is sandy clay. Most of the soils in these districts are degraded. The population density is high; consequently, there is a great pressure on land. Fallow periods are virtually non-existent, the soil being cultivated successively each growing season. However, occasionally there is forced fallowing when the land is allowed to rest, either because it has shown obvious signs of declining productivity and/or because of severe damage by cereals Striga. The two districts are located in the Sudan savanna and have annual rainfall of about 800 mm.

3.6. Description of Farming Practices of Farming Communities Involved in Sub-Project

3.6.1. Cropping system : Generally, intercropping is the predominant practice in both groups of farmers; the relative densities of the component crops are variable but they tend to depend on the quantity of seeds available for sowing during the planting season. However, sole cropping is the normal practice in the production of rice, cotton, soyabean and, sometimes, groundnut. Specifically, in Bimbilla District, yams are grown in pure stands and are the first crop in the rotation after the fallow period. Other crops in Bimbilla District are mixed. Tillage is by hoeing, while planting is on the ridge (groundnut is grown on top of the ridge, maize by the sides while sorghum is broadcast in the furrow, a practice that ensures good sorghum establishment since patridges eat a good proportion of the seeds). Maize and groundnut are simultaneously planted while sorghum is sown 3 weeks later. Sorghum is frequently adversely affected by mid-season drought. Cassava and pigeon pea are normally planted in the periphery of the farms; other minor crops are millet and bambara nuts.

In the Wa and Nadowli Districts there are three tillage practices:

(i) ridging done with ox-drawn plough; (ii) mounds made by hoe-farmers; and (iii) land clearing and

subsequent planting on the flat. In the two districts, soyabean, cotton, and, sometimes cowpea are sole-cropped. The major cereals, in decreasing order of importance are sorghum, millet, maize and rice. The minor crop is bambarra nuts, intercropped with other legumes or with cereals in cereals-dominated mixtures.

In Bimbilla District, farmers plant yam after the fallow, followed by maize/sorghum plus groundnut intercrop which is followed by sole crop sorghum or by sorghum/millet mixture.

3.6.2. Rotation or relay-cropping See comments about these in section 3.6.1. above.

3.6.3. Application of crop residue/manure: In Wa and Nadowli Districts, farmers apply cow dung which is transported to the farm in ox- or donkey-drawn carts. Application of organic manure in Bimbilla District is rare, apparently because of the low population pressure on the land.

3.6.4. Fallow practices: Land fallowing is rare in Wa - Nadowli sector; where fallowing is forced on the farmer (see reasons given above), its period hardly exceeds two years, In Bimbilla District, the fallow period is between 5 and 15 years.

3.6.5. Livestock and crops integrated enterprises In both areas, free-ranging of sheep and goat is the normal practice; however, the number of animals per farm-family is much lower in Bimbilla District than

in Wa-Nadowli Districts. Cattle and donkey and used in Wa-Nadowli Sector for traction, transportation and for provision of farm-yard manure.

3.7. Production Inputs

3.7.1. Land Preparation and planting: These have been described above (see item 3.6.1. of section 3.6). In brief, land is prepared by hoeing in Bimbilla District and planting is done on the ridge (groundnut is sown on top of the ridge, maize by the sides and sorghum is broadcast on the furrow); maize and groundnut are planted simultaneously, while sorghum is sown 3 weeks after planting of maize and groundnut. In Wa and Nadowli Districts land is prepared either by animal traction or by hoeing; planting is done on the ridge or on the mound or on the flat.

3.7.2. Fertilizer application: There is limited use of inorganic fertilizer, the quantities applied vary with the farmer's income. However, fertilizer application is restricted to cereals, especially maize. Indeed, fertilizers are not applied to sorghum /millet mixtures or to groundnuts. Cotton is sole-cropped and production inputs (including fertilizers and pesticides) are provided by the Cotton Development Board. On the whole, compound fertilizer are preferred, the following being the common (NPK) types: 15-15-15; 20-20-20; and 17-17-17 - these are applied

as basal treatments while suphate of ammonia is given as top dressing.

3.7.3. Crop protection memasures: Generally, no specific crop protection measures are applied, except for cotton. A recent development in the Wa and Nadowli Districts is that some farmers spray sole-crop cowpea with insecticides, having been convinced of the profitability of the input about 2 to 3 years ago.

3.7.4. Weed control: Weed control is by hoeing and hand-pulling; no herbicides are applied.

3.7.5. Family labour input and animal traction

Family labour is the main source of labour; when available animal traction is used in Wa and Nabowli Districts as noted above. Hired labour is occasionally used during peak activities but costs are variable.

3.8. Data Collected During the Study

3.8.1. Number of farmers within the project area. Data on number of farmers in the project areas are available only for Bimbilla District which has about 2,500 farm families.

3.8.2. Labour costs. Very little hired labour is employed and costs very a great deal. However, a common index is the cost of fertilizer required to produce 1 ha of maize; laboureres (themselves farmers) charge the equivalent of the amount of money required to purchase fertilizers for 1 ha of maize in order to weed 1 ha of a crop.

(Ghanain trials)

3.8.3 Input costs. One of the relevant inputs here is artificial fertilizer which is sold to farmers through the Farmers Services Supply Company as follows: NPK at 5,200 cedis/50 kg bag, and urea and $(NH4)_2SO_4$ at 4,000 cedis/50 kg bag. The other inputs are insecticides for cowpea spraying, the common ones being Cymbush and Karate, each of which is sold at 6,000 cedis/litre.

3.8.4. Yields: The following yields are normally attainable at the farmer's level: maize - 3 tons/ha, using improved vars and fertilizer; sorghum - 600 kg/ha; millet - 570 kg/ha; groundnut - 2 tons/ha of pods, using improved vars at high crop density; cowpea 1.2 tons/ha, using insecticidal sprays (at least 2 sprays).

3.9. Materials and Methods Used by Researcher for Sub-project Implementation

The methodology used in the two sectors differed and, therefore, two separate accounts are given below.

3.9.1. In the Wa and Nadowli Districts: Farmers in these districts were asked to select any two of the three packages tested.

3.9.1.1. Package I. Objectives: (i) To test the feasibility of introducing millet as a third crop in an already existing system of sorghum/cowpea mixture, and (ii) to assess the economic feasibility of the cropping patterns.

There were three treatments, namely:

Treatment A: Farmers' current pratice - sorghum

(Ghanian trials)

(var NSU-1) is sown on top of the mound while 4 hills of cowpea (Valenga var) are planted half way down the mound.

Treatment B: Same as treatment (A) but, in additon, local millet var is planted between the mounds 2 weeks after cowpea.

Treatment C: Same as treatment (A) but with millet first planted in a nursery on the same day of planting cowpea and transplanted between the mounds 4 weeks later.

In each case, plot size was 5 x 3 m, with mounds spaced at 100 x 50 cm.

Five out of the 22 farmers took this trial, each farmer constituting a replicate, although the treatments were in replicates in each farm and the results will be analysed as a RCB design.

3.9.1.2. Package II: Cereal/legume Rotation

Objectives: (i) To demonstrate compatible cereal /cereal mixture (i.e. maize mixed with sorghum in a 1:1 ratio), and (ii) to demonstrate effects of legume/cereal rotations on soil fertility maintenance.

Each farmer constituted a treatment and results will be analysed as a RCB design. The following comprised the teatments.

Treatment A: Farmer's practice of mixing maize, sorghum and groundnut; they were mixed at random.

Treatment B. The plot was divided into two; In 1990 one half was sole crop groundnut while the other half was a maize/sorghum mixture. Note that in 1991

maize/sorghum mixture will be planted in the 1990 groundnut plot while groundnut will be sown in the 1990 maize/sorghum plot. In 1990, 60:30:0 kg/ha of N, P_2O_5 and K_2O, respectively of compound fertilizer was applied, the plot size being 20 x 20 m.

3.9.1.3. Package III

Objectives: (i) To introduce white seed-coat cowpea into a system in which the red-testa cowpea (Vallenga) is already popular and to test farmers response to the white seed-coat cowpea, and (ii) to assess the economics of their production under farmers' conditions.

Three cowpea varieties, namely, Vallenga (IT82E-16) IT821D-1137 and IT83S-818) were planted either as sole crops (density 88,000 plants/ha) or in mixture with two varieties of sorghum (i.e. Nsu 1 and Naga white) both medium duration varieties; seed of a short duration variety (Belko) were not available in 1990 but will be included in the 1991 trila. Sole crop sorghum was planted at 53,300 plants/ha.

Cowpea was sprayed twice with Cymbush in 1990 (at pre-flowering and post-flowering stages of growth); in 1991 a mixture of cymbush and dimethoate will be used - dimethoate could not be purchased in 1990.

3.9.2. In the Bimbilla District: One package, consisting of two treatments, was being studied.

Treatment I. Farmers practice of mixing maize, sorghum and groundnut (groundnut on top of the ridge, maize on the sides and sorghum on the furrow).

Treatment II. Improved practice:

In 1990, 3 rows of maize/sorghum mixture or 3 rows of groundnut were alternated with one row of pigeon pea. Thus, 3 rows of either groundnut or maize/sorghum mixture were planted between two rows of pigeon pea. Plot size was 22 x 10 m, such that each plot contained 2, 3-row units of either groundnut or sorghum/maize mixture, the inter row spacing being 1.1m. Fertilizer was given as basal and top dressings only to maize in the maize/sorghum mixture.

In 1991, the pigeon pea will be pruned two weeks before planting but only into the plot in which groundnut was planted in 1990. Then maize/sorghum mixture will be planted in the plot in which groundnut was grown in 1990 while groundnut will be sown in the plot that contained maize/ sorghum in 1990. Also only top dressing with urea would be applied to maize.

For groundnut, two rows were planted on top of each ridge at an inter-row spacing of 20 cm (on the ridge) while the intra-row spacing was 10 cm. The inter-ridge spacing was 1.1. m. Maize was planted in a single row on the top of the ridge of 60 cm intra-row spacing . Sorghum was broadcast in the furrow but was later thinned to 27 plants per furrow of 10 m.

Each of the 30 farmers planted each of the two treatments.

Beacuse of the complex nature of the mixtures, the Researcher supervised the planting exercise in 1990.

3.10. Constraints Encountered in Project Implementation in 1990.

3.10.1. Drought: A mid-season drought affected both sorghum and millet in 1990.

3.10.2. Financial constraints (inflation)

Inflationary trends in 1990 affected the budget. For instance, each of the two motor cycles was budgeted at ₵ (US) 1,500.00 each but was eventually purchased at ₵1,809.00; thus inflation cost ₵618 on this single time. Also fertilizers cost more than was budgeted.

3.10.3. Mobility of researcher. The principal researcher has no official vehicle assigned to him by his employer. He has had to borrow from colleagues who, for obvious reasons, were unable to meet his needs.

3.11. Status of Sub-Project Implementation

The sub-projects were excuted according to approved project document.

3.12. Suggestions by the Assessor

(i) The package being tested at Bimbilla District is too complicated and should be simplified in 1991, especially if the farmers still have difficulty planting the trial without the assistance of the researcher.

(ii) With the expected timely provision of Project funds in 1991, efforts should be made to procure all input in time.

(iii) Given the distance between the two locations and between each of them and Nyankpala station, the

Government of Ghana should endeavour to procure a 4-wheel drive vehicle for the scientist. The ideal thing is for the Project to provide the vehicle, if this can be accomodated within the financial provisions.

(iv) It is not clear why money and time should be spent Package III evaluated in Wa and Nadowli Districts. There must be an easier and cheaper way to obtain the answer sought by that package. Not much will be lost by deleting it.

IV. PROJECT IMPLEMENTATION IN MARADI AREA OF NIGER

4.1. Sub-Project Title: Comparison of Improved and Traditional Systems of Millet/Cowpea Intercropping at Farmers' Level under the Supervision of the Researcher.

4.2. Objectives:

(i) To evaluate possible, technological options for the production of millet/sorghum intercrop, including analysis of the problems encountered in use of the different technologies;

(ii) to determine how best to modify the technologies in order to improve their productivity and subsequent adoptability by farmers; and

(iii) to familiarize the Extension Service with the new technologies.

4.3 Name of Research Institution: Ministere de L'Agriculture et de L'Elevage, INRAN, CNRA, Tarna, Maradi, Niger.

4.4. Researchers and Cooperators:

4.4.1. Executors of programme:

(i) Administration of Programme: Mr. Malik Kadi

(ii) Technical Coordinator: Chandra Reddy

(iii) Principal Researcher: Marou Hassan Zarafi

4.4.2. Collaborating researchers:

(i) James Lowenberg Deboer

(ii) Mme Marou Zarafi

(iii) Mr. N'Diaye Ahmadou

(iv) Mr. Salou Moussa

(v) Mr. Cherif Ari Oumarou

4.4.3. Collaborating institution: The Agricultural Extension Services.

4.5. Description of the Location

The 12 farmers involved in the sub-project were selected from three villages (Kagadama, Tajaye and Takalmawa) in the Madarounfa Local Government Area in the Atchidekofoto District near Maradi, Niger. The number of farm-families in the three vi villages were estimated at 200, 150 and 450 for Tajaye, Kagadama and Takalmawa, respectively.

The villages are in northern part of Sudan savanna with mean annual rainfall of 400 mm. The soils are predominantly sandy loam of average fertility.

4.6. Farming Practices of Farmers In Sub-Project Area

4.6.1. Cropping system: The farmers traditionally practise a large variety of cereal-based mixtures, viz. millet/cowpea; sorghum/cowpea; millet/sorghum/cowpea, and millet/groundnut. In addition, some crops are occasionally grown in pure stands, e.g., groundnut, cowpea, millet, cyperus, and sorghum.

4.6.2. Crop rotation: Some farmers practise crop rotation; an ideal rotation starts with millet which is followed by cowpea or groundnut, while cyperus is planted in the third year before the cycle begins again with millet or sorghum, each of which is often mixed with one of the legumes.

(Maradi trials)

4.6.3. Use of organic manure: Farmers apply organic manure derived from cattle, donkey, goat, sheep and poultry. Farmers without large number of livestock sometimes invite Fulani cattle rearers to settle in their fields during the dry season to ensure that dung is deposited on their farms.

4.6.4. Use of chemical fertilizers: Farmers apply limited quantities of various fertilizers (e.g., NPK, SSP, CAN, and urea) to 'gero' millet; single superphosphate is given as basal application while urea is given as top dressing. The amount of fertilizer used is severely related to the purchasing power of the farmer. Single superphosphate and compound fertilizer (NPK) cost 1,500 CFA/50 kg while urea (surprisingly) costs 3,500 CFA/50 kg.

4.6.5. Land fallowing: Only farmers with large farms can afford to leave land fallow for 2 - 3 years. The vast majority of farmers cultivate their land every growing season.

4.6.6. Livestock/crop integration: Animals (ruminants) feed on crop residue and produce organic manure for use in the farms. Bullocks and donkeys are used in land cultivation and in transportation of produce and peopole. An interesting point is the use of bulls to draw water from very deep wells.

(Maradi trials)

4.7. Production Inputs

4.7.1. Land preparation and planting: Just before the onset of the rains, the vegetation is cut down and burnt. In the traditional system, planting is then done with the onset of the rains, without any form of tillage. Ridges are made after the crop has emerged, at the time that seedlings are thinned. Only those that can afford to use animal power make ridges and apply basal single superphosphate fertilizer before sowing.

However, in both systems, planting can also be done on the flat.

4.7.2. Fertilizer application: See paragraph 4.6.4 above.

4.7.3. Crop protection: Most farmers appreciate the importance of spraying their crops to control insect pests. Those that can afford it, apply insecticides, mostly on cowpea, while some of this class of farmers also spray sorghum and millet. A wide range of pyrethroids (e.g., Decis ULV, Cypermethrin ULV, Karate ULV) are used; other insecticides used include dimethoate E.C., fenithrothion ULV and sumithion WP.

4.7.4. Weed control: No herbicides are used. Weeds are controlled by cultivation, using either hand-held hoes or animal-drawn implement.

(Maradi trials)

4.7.5. Family labour input: Labour is provided by members of the family, the marriage tradition being mostly polygamous. However, richer farmers employ hired labour to supplement family labour, especially during peak periods. Animal traction is used under the conditions described above.

4.8. Data Collected During the Study

4.8.1. Labour costs: One man-day costs 500 CFA, if the labourer is given meals; if food is not provided, a labourer is paid 600 CFA. Only men can be hired as labourers.

4.8.2. Yields: Average yield of sole crop millet is 500-600 kg/ha while sorghum yields 600 kg/ha. Well-distributed rainfall is necessary for sorghum grain production in the sub-project area; otherwise total failure of the sorghum could result, as occurred in 1988 and in 1989. Sole crop cowpea produces about 500 kg of grain per ha (if it is given two insecticide sprays) while unsprayed cowpea produces only about 100 kg/ha. Sprayed cowpea intercropped with millet or sorghum yields up to 200 kg/ha.

4.8.3. Farmers' reaction to the project: Farmers have responded favourably to the Project. All of the 12 farmers were so happy with the trials that they are looking forward to participating in the Project in 1991.

Indeed, many of the neighbouring farmers that did not participate in the Project in 1990 have volunteered to participate in 1991. The farmers were particularly happy with the yields of improved varieties of millet and cowpea and with the provision of fertilizers free of charge.

One technician apparently supervises all the 12 farmers. He has no paid assistant but he selected one man in each of the three villages to lead the 4-man group.

4.9. Materials and Methods

Number of treatments: three

Experimental design: randomized complete block.

Plot size: Each plot (treatment) measured 30 x 10 m; i.e., for the three treatments the experimental plots measured 900 m^2.

4.9.1. Treatment 1 (Traditional system): Farmer's system of planting; local varieties of millet and cowpea; sowing date was determined by the farmer.

4.9.2. Treatment 2 (Improved technology but without insecticide application to cowpea).

Millet variety: CIVT; cowpea variety: TN 5-78; planting pattern: one row of millet alternating with one row of cowpea; millet spacing: 1.5 x 0.75 m (8888 plants/ha); cowpea spacing: 1.5 x 0.375 m (17,777 plants/ha); date of millet sowing: first 2 weeks in June; date of cowpea sowing: 10-14 days after sowing of millet or 7-10 days after emergence of millet

seedlings; fertilizer: basal application of 100 kg/ha of single superphosphate.

4.9.3. Treatment 3 (Improved technology incluing insecticide sprays for cowpea).

The crop varieties, the plating pattern and other cultural practices were similar to those of Treatment 2. The only difference was that cowpea was sprayed twice with Cymbush ED.

4.10. Problems Encountered in Project Implementation

(i) Although the supervising technician was provided with a motorcycle to facilitate his visits to the farmers, no provision was made for the cost of fuelling the vehicle. Despite this handicap, he was required to visit the farmers weekly. Although input distribution to farmers was occasionally done by the Technician during his visits, farmers usually called at the field office to collect heavier inputs.

(ii) The crops were affected by end-of-season drought.

4.11. Status of Sub-project Implementation

The Sub-project was implemented, with virtually no modifications, according to protocol submitted to SAFGRAD. The results made a very favourable impact on the participating farmers and their neighbours.

4.12. Suggestions by the Assessor:

(i) Input distribution to farmers should be handled more formally in place of the current practice that requires farmers to visit the project office for their

inputs. The Maradi Station has a good number of pick-up vans that could be used to distribute inputs to farmers.

(ii) The situation that requires the technician to visit farmers weekly during the growing season without providing fuel for the officially-purchased motorcycle should be reviewed urgently. The distance from some of the farms to project office is up to 30 km. It is recommended that financial provision be made for fuelling the motorcycle.

V PROJECT IMPLEMENTATION IN GAYA AREA OF NIGER

5.1. Sub-Project Title Millet/Sorghum Mixed Cropping Trial

5.3. Objectives of Sub-Project

(i) To find the technological options for higher performance (productivity) of millet/sorghum mixture,

(ii) by conducting trials on-station and in farmers' fields, to provide an understanding of the difficulties encountered in the transfer of these technologies under actual conditions of the farmers, and

(iii) to find solutions to the problems encountered in (ii) above.

5.3. Name of Research Institute

Institute National de Recherches Agronomiques du Niger (INRAN), Kolo Station, Niamey.

5.4. Principal Researcher.

Mr. Mammane Nouri

5.5. Description of Location

The 11 farmers involved in the sub-project are located in Sokondii Birni village which is about 10 km off the town of Gaya (300 km south of Niamey). With an average annual rainfall of 770 mm, the village is in the southern part of Sudan savanna. The soil is sandy. The production constraints include low planting densities, insufficient use of chemical fertilizers, inadequate planting pattern, weeds, Striga attack, etc. There were about 2,000 (actually 1996)

farming families, each with an average size of 7 persons (2 parents plus 5 children). The average farmily farm is about 3-4 ha.

5.6. Description of Farming Practice

The dominant cereals are millet (the most important) and sorghum but there were small parcels of rice and maize. The main legume is groundnut grown in pure stand or in mixture with cereals. Cowpea is also grown as a secondary crop in the cereal-based system. Yield of millet and sorghum (in mixture) average 700 and 250 kg/ha (i.e. total grain yield is 950 kg/ha).

The millet is frequently relay-cropped with sorghum but some farmers relay-crop early millet with late millet.

There was no evidence of noticeable use of organic manure. The crop residue is used as animal feed or/and as construction materials.

There was little evidence of land fallow around the homesteads.

The main ruminant kept is the cattle, the oxen being used for carting of produce.

5.7. Production Inputs

Land is prepared manually by the farmer; sowing is also done manually. Weeding is by hoeing and in one farm the third weeding had just been completed while in

another it was about to commence. The rest had been weeded twice by the time the farms were visited on September 21, 1990.

Traditionally the farmers do not apply any fertilizers, nor do they employ any crop protection measures, apart from hoeing and hand-pulling to remove weeds and Striga.

Labour is provided mostly by members of the family but some farmers hire labour at 750 CFA per day, with provision of meals, or 1,000 CFA per day, if meals are not provided. Bulls are used mostly for drawing carts for human and produce transportation.

5.8. Data Collected During Study.

As noted above, the number of farming-families within the project area is 1,996. Each family, on the average, comprises seven members (two parents plus five children). The number of individuals per family is, however, much higher where a man has two or more wives; the community is predominantly moslem and polygamous.

Labour costs vary, depending on whether meals are provided (750 CFA per day of 8 hours) or are not provided (1,000 CFA per day).

Although farmers do not traditionally use fertilizers, the project provided fertilizers for three of the treatments; single superphosphate costs 55 CFA/kg while urea costs 50 CFA/kg.

(Kolo Station trials)

As already noted, the average annual grain production per ha is 950 kg (700 kg of millet plus 250 kg of sorghum).

5.9. Materials and Method.

The study comprised five treatments (T_1 - T_5) each of which was replicated 11 times (the farmers served as replicates, i.e., there were 11 farmers in the study). The treatments were as follows:

T_1. Farmers' traditional practice of millet/sorghum intercropping:

(i) variety of millet: local variety,
(ii) variety of sorghum: local variety,
(iii) date and method of planting: as practised in farmers' fields,
(iv) mineral fertilizer: none.

T_2. Improved traditional method; thus:
(i) to (iii) as in T_1
(ii) mineral fertilizer: 20 kg P_2O_5 + 46 kg N/ha shared by millet and sorghum.

T_3. Improved package without monetary input:
(i) millet variety: CIVT,
(ii) sorghum variety: BKC,
(iii) millet spacing: 1.5 x 0.75 m,
(iv) sorghum spacing: 1.5 x 0.75 m, one row of sorghum alternating with one row of millet, i.e., 1:1 mixture),

(v) date of planting for sorghum: 10-14 days after millet.

(vi) mineral fertilizer: none

T_4. Improved package with limited inputs:

(i) - (ii) similar to those in T3,

(iii) millet spacing: 1.5 x 0.5 m,

(iv) sorghum spacing: 1.5 x 0.5 m,
(1:1, millet: sorghum mixture),

(v) sowing date for sorghum: 10-14 days after millet

(vi) mineral fertilizer: 20 kg/ha P_2O_5 shared by sorghum and millet.

T_5. Complete package: thus:
(i) - (v) as in T_4, (vi) mineral fertilizer: 20 kg/ha of P_2O_5 + 45 kg/ha of N shared equally by millet and sorghum.

5.10. Problems Encountered in Sub-project Implementation

The researcher did not experience any major problem in implementation of the project. He appeared to be reasonably happy with logistic and technician support provided by his employer. The main problem was that some of the farms were inaccessible by road during most of the rainy season. Even during the study in the third week of September, the study group's 4-wheel drive vehicle got stuck in the mud on our way to the village. Wa were pulled out eventually by another vehicle with a towing chain.

5.11. Status of Project Implementation

(i) Project is being implemented according to approved proposal except that the treaments were not replicated in the 11 farms because the farmers were reluctant to commit more of their land to the trial which, being the first of its kind, they were unsure of its likely benefits.

(ii) Instead of sowing two plots of each treatment in each farm, the researcher decided to sow only one plot. Since each farm constituted a replicate, this modification would not invalidate statistical analysis of the results of the trial.

(iii) Project objectives, by and large, have been attained. The main lesson conveyed by the 1990 trial was that both millet and sorghum (both improved and local varieties) responded to N fertilizer applcia-tion while there was no response to P_2O_5.

5.12. Suggestions by the Assessor

(i) Some farmers planted cowpea as a third crop in the mixture/relay and many cowpea plants had fairly good pod load, probably because of low insect pressure. Whatever is the reason, it is suggested that cowpea be introduced as the third crop of the system in 1991 - the yield (fodder & grains) will be a bonus, while the cowpea will contribute to soil N.

(ii) The improved sorghum variety used in the trial (BKC) is too tall and is likely to be severely affected by stem lodging in years with windy storms. It should be replaced by a shorter variety.

(Kolo Station trials)

(iii) To enable the researcher visit his trials more frequently during the growing season, the road to the villages should be made motorable thoughout the rainy season.

VI. PROJECT IMPLEMENTATION IN NIGERIA

6.1. Sub-Project Title:

On-station and On-farm Agronomic Testing of Appropriate Technologies for Sorghum, Millet, Maize and Cowpea in Crop Mixtures.

6.2. Objectives of Sub-Project.

(i) To study the performance, and farmers acceptability, of improved varieties of sorghum, millet and cowpea as compared to traditional farmers' varieties.

(ii) To validate, both on-station and on-farm:

(a) improved varieties for maize/cowpea mixture, and

(b) rate of fertilization in maize/cowpea mixture; in both cases the ultimate objective is to study the acceptability of the technologies to farmers.

6.3. Name of Research Institute.

Institute for Agricultural Research, Samaru, Ahmadu Bello University, Zaria, Nigeria.

6.4. Researchers.

6.4.1. Principal researchers: Dr. K. A. Elemo and Dr. O. O. Olufajo

6.4.2. Collaborators: One Agricultural Economist and Soil Scientist.

6.5. Description of Location.

The on-station trials were located at the research farm of the Institute for Agricultural Research, Samaru (11° 11' N, 07° 38' E, 686 m above mean sea level) located in the northern Guinea savanna agro-ecological zone. The environment has a distinct wet season (May to September/October, with total annual precipitation

averaging about 1,000 mm) and a dry season (which is cool in October to March but warm in March to May). The soil at the site is of well-drained ferroginous tropical soil that is characteristically sandy loam. Production constraints include pests and diseases, uneven distribution of rainfall, and unpredictable onset and cessation of the rains, non-availability of fertilizer at the appropriate time and labour bottlenecks, among others.

6.6. Description of Farming Practice of Participating Farmers: Sub-project is presently at the on-station phase of implementation.

6.7. Production Inputs: The inputs varied with the type of trial.

For Trial 1 (Objective (i) above). Land preparation was by the local method, using traditional hand tools. Compound fertilizer (15: 15: 15) was applied only to the cereal at the rate of 30 kg/ha each of N, P_2O_5 and K_2O (i.e., one half the recommended rate for sole crop sorghum or millet). Cymbush (cypermethrin) and Rogor (dimethoate) were applied at 1.0 litre/ha each, at 14-day interval, beginning at flower bud formation; three applications were given. Weeds were controlled mannually, using the hand-held hoe.

For Trial II (Objective (ii a) above). Land preparation (ploughing, harrowing and ridging) was done with the tractor. Fertilizer was applied at 120 kg N/ha and 60 kg/ha each of

P_2O_5 and K_2O as NPK (22: 13: 13) and CAN. Cowpea seed was treated with benomyl at the rate of 1.0 g of product/1 kg of seed. Insect pests were controlled with three sprays of a mixture of Cymbush EC (cypermethrin) and Rogor (dimethoate) at the rate of 100 + 100 ml of products per ha. Weeds were controlled by three hoe-weedings.

For Trial III (Objective (ii b) above). Land preparation was done with the tractor. Cowpea seeds were sown between maize stands on 90-cm ridges at about 5 weeks after sowing of maize. Fertilization was the subject of the study; thus four levels of N, three of P_2O_5 and two of K_2O were studied in all possible combinations (see materials and methods). The cowpea was sprayed with insecticides as described above for Trial I. Weeding was also done as described for Trial I.

6.8. Data Collected by the Researchers:

For Trials I and III, the data collected included number of days to 50% flowering, grain yield, yield components, and physico-chemical properties of the soil. For Trial II, the following data were collected: costs of labour and inputs, yields of the component crops, land equivalent ratios, yield components; in addition, an economic analysis of the cropping system was done.

6.9. Materials and Methods

6.9.1. Trial I (Objective (i) above): The second year of a two-year trial was conducted on-station in 1990 at Samaru to determine the varieties of the

respective crops to be used in a sorghum/millet/cowpea mixture. This trial was designed to preceed another 2-year on-farm trial in 1991 and 1992.

The general cultural management practices of the local farmers for producing sorghum/millet/cowpea mixture were adopted to the on-station studies. The 1989 ridges were split immediately after the first substantial rain of the season with the aid of the traditional hoe. This involved the cutting of heaps of soil from the top of 1989 ridge into the adjacent furrow. Seeds of sorghum and millet were then planted immediately on this heap of soil in alternate, single hills, spaced 50 cm along the row, During the first manual weeding, 2-3 weeks after sowing, the old (1989) ridges are completely flatened in the process. After the weeding, fertilizer was applied to the cereal crops at the rate of 30 kg each of N, P_2O_5, and K_2O per ha, using a compound fertilizer (15-15-15). Cowpea was interplanted near the millet stands shortly before millet was harvested.

One improved sorghum variety, KSV8, a medium maturing cultivar, was compared with Farafara (a local variety). Similarly, an improved millet variety (SE 13) was compared with a local variety, Zango. For cowpea, of three improved cowpea varieties, namely Kano 1696 (late maturing and white seeded), Sampea 7 (medium maturing and light brown seeded) and IT84S-2246-4 (medium maturing and light brown seeded) were compared with a local variety. Plot size was 6 x 7 m.

(Nigerian trials)

6.9.2. Trial II (Objective (ii a) above): Two varieties of maize, TZBSR and a hybrid (Ex-Kaduna), were intercropped with four cowpea varieties, namely Sampea 1 (IAR 339-1), Sampea 6 (Kano 1696), Sampea 7 (IAR 48), and one local variety. Sole plots of each component crop were included. In both sole and intercrop, maize and cowpea were established at 53,330 plants/ha on 90-cm ridges. Maize was sown on 16 June and cowpea on 10 August, 1990. In intercrops, maize and cowpea were sown on the same row. The gross plot size was 5.4 x 6 m. The experiment was laid out in randomized complete block with four replications.

6.9.3. Trial III (Objective (ii b) above): The second year of a two-year trial was executed on-station at Samaru in 1990 to determine the appropriate fertilization of maize/cowpea mixture. The trial will be followed by a 2-year on-farm trial scheduled for 1991 and 1992.

A composite soil sample of the experimental site was taken before the trial was established. Maize variety, TZBSR, was sown at 60 cm spacing along ridges spaced 90 cm apart. Each was 5.4 m wide and 6 m long. The fertilizer treatments comprised four levels of nitrogen (0, 75, 150 and 225 kg N/ha), three levels of phosphorus (0, 40 and 80 kg P_2O_5/ha) and two levels of potassium (0 and 40 kg K_2O/ha). These were laid out in a randomized complete block design with four replications.

The maize was later thinned to three plants per stand while the cowpea was intersown into the maize stands at spacing of 20 cm at two seeds per hole without subsequent thinning.

6.10. Status of Project Implementation

Trial I: The 1990 trial was an implementation of the approved proposal. This successful implementation of the approved second year's trial of the 2-year, on-station sub-project means that the project is ready to go on-farm for the first time in 1991.

Trial II: The trial was executed in 1990 according to the approved proposal, with only minor but necessary modifications. Thus, the maize variety, EV8444SR, was replaced by hybrid maize (Ex-Kaduna) in view of the increasing popularity of hybrid maize in the Zaria area. Similarly, the cowpea variety Sampea I was added as an additional improved variety to satisfy the needs of farmers that may wish to produce white-seeded photoperiod-insensitive variety.

Trial III: The trial was implemented according to approved proposal with a minor modification; thus the fertilizer treatments were expanded to include all possible combinations of four levels of N, three levels of P_2O_5 and two levels of K_2O.

Problems encountered in implementing Trial II of the project was an end of season drought that adversely affected the relatively late-sown cowpea which was also

attacked by Alectra vogelii, a parasitic weed. For all trials, the mobility of research staff is still problem that will become more accute when the trials go on-farm in 1991 and 1992. Some amelioration is expected from the two motorcyles purchased for use by the technicians. Even here, the number of motorcycles will have to be increased to about five to ensure effective coverage of farmers fields as from 1991. The researchers believe that their effectiveness will be increased if they are provided with a Project motor car, preferably a 4-wheel drive.

Despite the above, the project objectives for 1990 were fully attained.

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(October, 1990)

1990-10

REPORT OF THE STUDY TO ASSESS THE IMPLEMENTATION OF THE FOOD GRAIN TECHNOLOGY VERIFICATION PROJECT

OUA/CSTR-SAFGRAD

OUA/CSTR-SAFGRAD